American Diploma Project
Web-Only Workplace Tasks and Postsecondary Assignments

Web-Only Workplace Task #1
Production Manager & Industrial Engineer
A national plastics manufacturer

Competition creates pressure on manufacturers to maximize efficiency. Wasting materials, time and even space can turn success into failure and profits into losses. At a plastics manufacturing company, an **industrial engineer** must determine how much of each raw material is needed to produce the required amount of ceramic powder and avoid waste. The mathematics and language skills needed to analyze such a production process are arithmetic using units and rates, the ability to do simple dimensional analysis, and the ability to gather relevant information and report findings in a timely manner.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Production manager	Median annual earnings were $61,660 in 2000.	Bachelor’s degree	255,000 jobs in 2000	Slower than average
Industrial engineer	Median annual earnings were $58,580 in 2000.	Bachelor’s degree	198,000 jobs in 2000	Slower than average

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks
ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	A7
	Research	D2, D4
	Informational Text	F1
Mathematics	Number Sense and Numerical Operations	I1.1, I1.2, I4.2
	Algebra	J5.1
	Geometry	K8.1
	Data Interpretation, Statistics and Probability	L1.3, L1.6

Sample Task

To fulfill an order for tinted plastic lenses, the plastics manufacturing company must first produce ceramic powder made from a mixture of three raw materials — A, B and C — in the ratio 10:3:1 by weight. The raw materials are mixed, baked and ground to a powder. The powder then is screened to remove lumps. The screening removes on average 15 percent, but the lumps can be returned to the raw mixture and reprocessed so they are not wasted.

The **production manager** consults with an industrial engineer, who must specify the ratios of raw materials needed to meet quality specifications of the job. The production manager then assigns a **production and planning clerk** to calculate the order and ensure the timely delivery of the appropriate quantities of the raw materials needed to produce 1,000 blocks, each weighing 2.5 kg on each of seven consecutive production days.

Ignoring the waste for a moment, the total amount of powder needed for one day is

$$\frac{1000 \text{ blocks}}{\text{day}} \times \frac{2.5 \text{ kg}}{\text{block}} = 2500 \frac{\text{kg}}{\text{day}}.$$

Since the powder is produced from the raw materials in the ratio of 10:3:1, the total of 2,500 kg needs to be divided into 14 parts: 2500/14 kg = 178.6 kg per part. Thus the after-waste weights of the three ingredients A, B and C will be

W_A = after-waste weight of A = 10 x 178.6 kg = 1786 kg.
W_B = after-waste weight of B = 3 x 178.6 kg = 536 kg.
W_C = after-waste weight of C = 1 x 178.6 kg = 179 kg.

If the production clerk started with these amounts on the first day, the output would be 15 percent short because of the screening loss in grinding.

To meet demand at the end of the day, the **machine operator,** following the written instructions from the production manager, must add additional raw material. The necessary amount for each raw material can be calculated most easily from the ratio:

$$\frac{\text{Before-waste weight}}{\text{After-waste weight}} = \frac{1.00}{1.00 - .15} = \frac{1.00}{.85} = 1.1765.$$

This means that the before-waste weight of each ingredient must be 17.65 percent larger than the desired after-waste weight. So the extra material that must be ordered is

X_A = extra amount of A = .1765 x 1786 kg = 315 kg.
X_B = extra amount of B = .1765 x 536 kg = 95 kg.
X_c = extra amount of C = .1765 x 179 kg = 32 kg.

The operator must use an extra 315 kg of A, 95 kg of B and 32 kg of C to complete the order on the first day. This will result in 2,500 kg of ceramic at the end of the day, with 442 kg to be recycled on the next day.

For each of the next six days, the operator needs to use 1,786 kg of A, 536 kg of B and 179 kg of C. The recycled material from the previous day takes care of the 15 percent waste. The total order for each of the raw materials for the week's production is (rounded up):

- Material A: (7 x 12,500 kg) + 315 kg = 87,815 kg.
- Material B: (7 x 3,750 kg) + 95 kg = 26,345 kg.
- Material C: (7 x 1,250 kg) + 32 kg = 8,782 kg.

This work is just a starting point in the analysis of the scheduling problem. In the workplace, it often is necessary to ask how the solution will change if some of the assumptions change.

- The level of waste (15 percent) actually is not fixed but will change from day to day. The industrial engineer has collected data to show that the level of waste fits a normal distribution with a mean of 15 percent and a standard deviation of 2 percent. How should the production manager take this new information into account?
- The production and planning clerk realizes that product is not shipped every day but only once every seven days. It is necessary only to *average* 1,000 blocks per day for seven days. Does this added flexibility allow the company to order lower quantities of the raw materials?

Web-Only Workplace Task #2
Industrial Engineer & Statistician
Veeder-Root, *Simsbury, Connecticut*

Many companies face the challenge of demonstrating that their products satisfy some type of quality, reliability, safety or environmental criteria. In these situations, there is no single correct answer, but a trade-off between two competing objectives such as maximizing safety while controlling costs. Veeder-Root, a manufacturer that supplies gas stations with submersible pumps and pressurized line-leak detectors, must demonstrate to the California Air Resources Board (CARB) that its new diagnostic system for monitoring the gas station vapor-recovery systems complies with CARB regulations: The diagnostic system must catch at least 95 percent of all true failures with no more than 1 percent false alarms.

The primary tools needed to make decisions regarding quality and safety on the one hand, and the costs involved on the other, include basic probability, statistics and algebra (including the binomial theorem). This task also requires the ability to conduct research, give and follow directions, summarize technical text, and — for its written report and oral presentation to the regulatory board — develop ideas systematically and make effective arguments.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Industrial engineer	Median annual earnings were $58,580 in 2000.	Bachelor's degree	198,000 jobs in 2000	Slower than average
Statistician	Median annual earnings were $51,990 in 2000.	Bachelor's or master's degree	19,000 jobs in 2000	No change, but job opportunities should remain favorable for individuals with statistical degrees, although many of these positions will not carry the explicit job title of statistician.

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks
ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	A1, A6
	Communication	B1, B7
	Writing	C1, C2, C3, C4, C5
	Research	D1, D2, D5
	Informational Text	F1, F3
Mathematics	Number Sense and Numerical Operations	I1.2, I3, I4.2
	Algebra	J1.1, J5.4, J6
	Data Interpretation, Statistics and Probability	L1.2, L4.1, L4.4, L4.5

Sample Task

Veeder-Root and CARB must agree on certification tests that demonstrate compliance: a sequence of failure-mode tests to determine if the diagnostic system meets the first CARB requirement that the diagnostic system must catch 95 percent of all true failures (the 1 percent false alarm level is tested differently). Working together, Veeder-Root and CARB **engineers, statisticians** and **technicians** develop and perform these certification tests. A technician working for CARB will visit a test station to set up a sequence of simulated failures (blocking the vapor-recovery hose). The CARB technician then will check to see if the diagnostic system catches each of these "true failures." **Industrial engineers** and statisticians from Veeder-Root and CARB must agree on the number of tests that are sufficient to certify a system as accurate.

There are two types of error to consider in this problem:

- fail a system that is actually good and
- pass a system that is actually bad.

Veeder-Root is most concerned about limiting the chances of the first type of error. CARB is most concerned about limiting the chances of the second type.

- The Veeder-Root engineers argue that a sequence of three tests is sufficient. The statisticians at CARB argue that this number is not sufficient to support the company's claim of 95 percent accuracy. What would the statisticians have to show to prove their point? What is the probability that a bad system, one working at only 80 percent accuracy, would pass this test?
- The statisticians from CARB want to require that the system catch seven out of seven failures in a test. The Veeder-Root statisticians argue that this requirement is too stringent. What can Veeder-Root show to demonstrate its point? What is the probability that a good system will fail the CARB test?

The engineer or statistician would use a spreadsheet to analyze many different types of tests. For example, the probability that a system with a 95 percent success rate will catch $X = 3$ out of three simulated failures is

$$P(X = 3 \mid p = 0.95) = 0.95^3 = 0.857.$$

The following table records the probability of passing the system if it is operating at accuracy level p and the certification test requires n out of n successful trials.

Probability of Passing a System

p \ n	3	4	5	6	7
0.6	0.22	0.13	0.08	0.05	0.03
0.7	0.34	0.24	0.17	0.12	0.08
0.8	0.51	0.41	0.33	0.26	0.21
0.9	0.73	0.66	0.59	0.53	0.48
0.95	0.86	0.81	0.77	0.74	0.70
0.99	0.97	0.96	0.95	0.94	0.93

Once the research is complete, Veeder-Root must submit a written report and make an oral presentation of its findings and analysis to CARB for its new diagnostic system to be certified.

The full certification problem is much more complicated. For example, the diagnostic system actually must be able to detect as many as eight different types of failure. The company would like to argue that one "random" error in the failure-mode test is not sufficient to fail the entire system. How many trials are sufficient if the system is allowed one error in *n* trials?

Perhaps the main difficulty in this problem lies in clearly defining a "bad" system. In particular, it is very difficult to develop a test that will distinguish a "bad" system working at 94 percent accuracy from a "good" system working at 95 percent accuracy. The most important lesson learned in the mathematical analysis here could be the value of providing better definitions of good and bad systems.

Web-Only Workplace Task #3
Forester
Boise Cascade Corporation, *Boise, Idaho*

Timber is a renewable natural resource, and the survival of timber-based industries depends upon the continued and reliable availability of timber. The value of a tract of forest is based not only on how many trees may be harvested immediately, but also on how many trees will be available for harvesting in perpetuity. In bidding on a tract of forest, a **forester** working for Boise Cascade — an international distributor of office supplies and paper and an integrated manufacturer and distributor of paper, packaging and building materials — must evaluate how much of the tract can be harvested and when to maximize the profitability and to protect the long-term stability of the forest for future harvesting. Such an evaluation requires the use of an industry "yield formula," a calculator or computer, high school algebra and research skills.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Forester	Median annual earnings in 2000 were $47,140.	Bachelor's degree	29,000 jobs in 2000	Slower than average

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks
ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Research	D1, D2, D4
Mathematics	Number Sense and Numerical Operations	I4.2
	Algebra	J2.6, J4.7, J4.8, J5.5

Sample Task

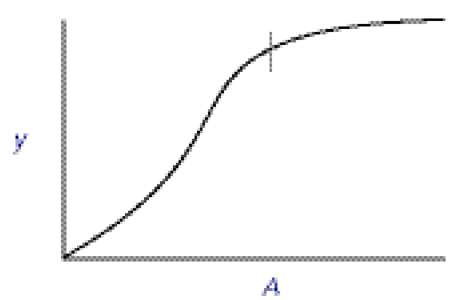
In forestry, the relationship between the age of a stand of trees and the yield (timber volume) in that stand are described with the following "yield equation":

$$y = y(A) = k \cdot e^{-b/A}$$

where

- $y = k\,e^{-b/A}$ (y = yield, e is the base of natural logarithms),
- A = stand age, and
- k and b are constants that depend on the type of stand (species, geography, etc.).

The following graph shows a typical yield curve.



The forester must determine the age at which trees ought to be harvested to sustain the forest and maximize the profitability of land. This optimal age is known as the Mean Annual Increment (MAI).

$$\text{MAI} = \frac{\text{yield}}{\text{age}} = \frac{1}{A} \cdot k e^{-b/A}$$

The forester must graph the MAI and show that the curve does have a maximum at this point.

Web-Only Workplace Task #4
Construction Manager
Associated General Contractors of Kentucky, *Frankfort, Kentucky*

Managers often are tasked with providing information and instructions to the workers they supervise. It is the responsibility of the **construction managers,** for instance, to brief **construction workers** regarding safety guidelines such as company policies and U.S. Occupational Safety & Health Administration (OSHA) regulations in a manner that is clear and easily understood. In communicating this information verbally to the workers in a "toolbox talk," the manager must speak clearly and precisely, staying aware of the audience's English proficiency. The construction workers must listen to and take away from the manager's presentation the needed information and follow any directions given. The safety of the operation depends on all of these players putting these skills to use.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Construction manager	Median annual earnings in 2000 were $58,250.	Traditionally, persons advance to construction management positions after having substantial construction experience or after having worked as construction supervisors.	308,000 jobs in 2000	Average
Construction workers	Median hourly earnings in 2000 were $11.15.	On-the-job training or formal apprenticeship programs	791,000 jobs in 2000	Average

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks
ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	A1, A6, A7
	Communication	B1, B6
	Informational Text	F1, F2, F3, F5, F8

Sample Task

A construction manager must prepare his crew for the task of clearing fallen rocks from a roadway; explosives will be used to remove large rocks. This common but dangerous task is accompanied by many inherent risks, including flying rock, premature detonation, vibration, air-overpressure and environmental pollution. Although the blaster is responsible for setting and detonating the explosives, safety is the responsibility of the construction manager and every member of the construction crew. To convey safety instructions effectively to the construction crew, the construction manager must read the following set of OSHA regulations attentively, understand the technical information it contains and extrapolate the most important information. This "toolbox talk" will serve as a general overview to reinforce awareness of the safety issues at hand.

Occupational Safety & Health Administration Regulations (Standards - 29 CFR) - Firing the blast. - 1926.909

• Part Number:	1926
• Part Title:	Safety and Health Regulations for Construction
• Subpart:	U
• Subpart Title:	Blasting and the Use of Explosives
• Standard Number:	1926.909
• Title:	Firing the blast.
• Applicable Standards:	1910.109(a)(12); 1910.109(e)(3)(iii); 1910.109(g)(2); 1910.109(h)(3)(ii)

1926.909(a)
A code of blasting signals equivalent to Table U-1 shall be posted on one or more conspicuous places at the operation, and all employees shall be required to familiarize themselves with the code and conform to it. Danger signs shall be placed at suitable locations.

1926.909(b)
Before a blast is fired, a loud warning signal shall be given by the blaster in charge, who has made certain that all surplus explosives are in a safe place and all employees, vehicles, and equipment are at a safe distance, or under sufficient cover.

1926.909(c)
Flagmen shall be safely stationed on highways that pass through the danger zone so as to stop traffic during blasting operations.

1926.909(d)
It shall be the duty of the blaster to fix the time of blasting.

1926.909(e)
Before firing an underground blast, warning shall be given, and all possible entries into the blasting area, and any entrances to any working place where a drift, raise, or other opening is about to hole through, shall be carefully guarded. The blaster shall make sure that all employees are out of the blast area before firing a blast.

TABLE U-1:
WARNING SIGNAL: A 1-minute series of long blasts 5 minutes prior to blast signal.
BLAST SIGNAL: A series of short blasts 1 minute prior to the shot.
ALL CLEAR SIGNAL: A prolonged blast following the inspection of blast area.

Web-Only Postsecondary Assignment #1
Introductory Physical Sciences,
University of California, *Irvine, Californmia*

Introductory courses in chemistry and physics at the University of California, Irvine, challenge students to organize and display data, graph linear equations, detect patterns, interpret graphs, use technology such as graphing calculators appropriately, and present solutions in the appropriate unit of measure or dimension.

Associated Benchmarks
ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	A7
	Informational Text	F1, F5
Mathematics	Number Sense and Numerical Operations	I4.2
	Algebra	J3.2, J4.1, J4.2, J4.8, J5.1
	Geometry	K8.1
	Data Interpretation, Statistics and Probability	L1.1, L1.5, L3.4

Sample Task

A 100-ml syringe piston has been set up in a science classroom so that the downward force on it can be changed by piling on textbooks and the volume of the air trapped in the syringe can be measured.

The table shows the values the students obtained as they put more books on the syringe.

Number of books	Volume in ml
1	90.0
2	45.0
3	30.0
4	22.5
5	18.0

a. Plot these data on a graph, with volume on the vertical axis and number of books on the horizontal axis.
b. What relationship (i.e., function) between the two variables is demonstrated by this information?
c. How could you change the data so that a direct proportionality exists between two variables related to these quantities?
d. Create a table of your new data, and draw a graph to show the proportionality.
e. Which of your two graphs makes it easier to predict the volume if six books were used? Explain why.
f. Is the relation not valid if points do not fall exactly on your line? How could you calculate a value for the uncertainty or measure of agreement? Show the calculation.

Web-Only Postsecondary Assignment #2
Introductory Engineering
Worcester Polytechnic Institute, *Worcester, Massachusetts*

Introductory engineering courses at Worcester Polytechnic Institute in Worcester, Massachusetts, challenge students to understand number systems, use calculators appropriately and make estimations without a calculator, detect potential calculation errors, know and use the basic trigonometric identities, and graph trigonometric functions. For each of these tasks, students are asked to consider the information and examples provided and then to follow the directions to reach a solution.

Associated Benchmarks
ADP benchmarks that address the knowledge and skills required to complete these tasks are:

CONTENT AREA	STRAND	NUMBER
English	Language	A7
Mathematics	Number Sense and Numerical Operations	I1.1, I3, I4.1
	Geometry	K12.2, K12.3

Sample Task #1

One skill that engineers and engineering students must develop is the ability to translate one mathematical model into another quickly and with fluency.

For example, the following equations describe the motion of a vibrating spring:

$$x(t) = x_0 \cos(\omega \cdot t) + \frac{v_0}{\omega} \sin(\omega \cdot t).$$

In most engineering applications, this formula is translated into a simpler form, using basic trigonometric identities. The new formula is

$$x(t) = A \sin(\omega \cdot t + \phi)$$

in which the amplitude of the motion is the constant A and the "angle" ϕ acts as a shift in time. Use some basic trigonometric identities to show that the two formulas are connected by the relationships

$$A = \sqrt{x_0^2 + v_0^2 / \omega^2} \quad \text{and} \quad \tan(\phi) = \frac{x_0 \cdot \omega}{v_0}.$$

Sample Task #2

A fundamental model used in engineering is the forced oscillator. It arises in models ranging from automobile suspension to electric circuits. One example has a solution in the form

$$x(t) = \left(\frac{1}{1-\omega^2}\right) \sin(\omega \cdot t)$$

where ω is the frequency of an external force. What happens as omega gets close to 1? The bridge collapses, the washing machine goes off balance, your radio picks up a clear station, etc.

In a particular application, when $\omega = 1$, the formula for $x(t)$ becomes

$$x(t) = \frac{1}{2} t \sin(t),$$

which describes oscillations with increasing amplitude. How long will it take for the amplitude to reach 100? 1,000?

Sample Task #3

A standard approximation used in engineering is the Taylor polynomial. For example, for x close to 0,

$$\sin(x) \approx x - \frac{1}{6}x^3.$$

Use this to estimate the error that is made in approximating $\sin(x)$ by x for $|x| < 0.1$ radians.

Sample Task #4

If you listen to two tuning forks that are very close in frequency, you will hear a phenomenon called "beats." The phenomenon can be explained by a trigonometric identity.
When you strike the two tuning forks, you are combining two trigonometric functions:

$$\cos(\square \cdot t) - \cos(\square \cdot t).$$

Use the identity $\cos(\mathrm{A}) - \cos(\mathrm{B}) = 2\sin\big((\mathrm{B} - \mathrm{A})/2\big) \cdot \sin\big((\mathrm{B} + \mathrm{A})/2\big)$ to rewrite the original formula as a product of a "fast" signal and a "slow" signal.

Web-Only Postsecondary Assignment #3
Introductory Economics
Indiana University Southeast, *New Albany, Indiana*

The study of economics involves developing an understanding of how classroom lessons relate to real-world topics such as pollution, education, discrimination, poverty and health care. These one- to two-page "*Wall Street Journal* assignments" from an introductory economics course at Indiana University Southeast focus on microeconomic topics such as demand/supply and market structures and on macroeconomic issues such as economic growth and the benefits and costs of government activism in trying to regulate the business cycle. These assignments challenge students to model and solve problems, define and narrow a problem or research topic, gather relevant information from print and electronic sources, identify interrelationships between and among ideas and concepts within text such as cause-and-effect relationships, and synthesize information in academic essays.

Associated Benchmarks
ADP benchmarks that address the knowledge and skills required to complete these tasks are:

CONTENT AREA	STRAND	NUMBER
English	Language	A1, A2, A6
	Writing	C1, C2, C3, C4, C5, C9
	Research	D1, D2
	Informational Text	F2, F3, F4, F5, F6, F7
Mathematics	Algebra	J4.3, J5.1, J5.2, J5.4
	Data Interpretation, Statistics and Probability	L1.1, L3.4

Sample Task #1

Find two articles in the *Wall Street Journal* that have quotes from economists, are written by economists and are about economists. (1) Provide a summary of the articles. (2) What were the economists' contributions to each article? (3) Turn in copies of the articles.

Sample Task #2

Find an article from the *Wall Street Journal* that covers one of the topics (listed below) that we have covered in the first half of the class. (1) Provide an overview of the topic. (2) Provide a summary of the article. (3) Explain how the article illustrates or relates to the topic that you chose. (4) Include a copy of the article.

Topics:

- Economic Growth
- PPF
- Productivity Slowdown
- Economic Systems
- Demand and Supply
- Transition Economies
- U.S. Farm Policy
- Price Controls
- Monopoly
- Cartel
- Government and Taxes
- Pollution
- Crime and Drugs
- Educational Reform
- Poverty and Discrimination

Sample Task #3

Find an article in the *Wall Street Journal* that discusses a topic related to your major or intended major. (1) Summarize the article. (2) Explain how it relates to your major and how the information and analysis in the article would be useful to someone working in your field. (3) Include a copy of the article.

Sample Task #4

Pick two macroeconomic variables, such as the unemployment rate, GDP, inflation, a particular interest rate, the exchange rate for a particular country, etc. Investigate fluctuations in these two variables from January 2001 through March 2002. Discuss the variables' trends and some of the factors that explain fluctuations in these variables.

Sample Task #5

Find an article in the *Wall Street Journal* that covers one of the topics (listed below) that we have covered in the last half of the class. (1) Provide an overview of the topic. (2) Provide a summary of the article. (3) Explain how the article illustrates or relates to the topic that you chose. (4) Include a copy of the article.

Topics:

- Health Care
- College Education
- Social Security
- GDP
- Defining and Measuring Inflation
- Output and Price Level
- Measuring Unemployment
- Policies to Reduce Unemployment
- Effects of Inflation, Inflation and Policy
- Debts and Deficits
- World Trade
- Comparative Advantage Revisited
- Balance of Payment and Exchange Rate

Web-Only Postsecondary Assignment #4
Introductory English
Georgia State University, *Atlanta, Georgia*

First-year English courses require students to read and evaluate texts critically and logically. This assignment from an introductory English course at Georgia State University in Atlanta gives students experience with identifying common logical fallacies in print and electronic texts. Having a road map of common logical fallacies and an understanding of why these fallacies do not prove the point being argued are skills that enable to students to evaluate arguments, judge the credibility of sources, and understand and present complex information effectively in this and other courses.

Associated Benchmarks
ADP benchmarks that address the knowledge and skills required to complete these tasks are:

CONTENT AREA	STRAND	NUMBER
English	Research	D2, D3
	Logic	E5
Mathematics	Geometry	K1

Sample Tasks

1. Create examples for each of the following types of fallacies.
2. Find a book in the library or at a bookstore and locate examples of two types of fallacies listed below.
3. Find a Web site of fallacies on the Internet. Choose three types of fallacies not listed below. Write an example of each.

Logical Fallacies

Though there are different kinds of arguments, any argument can be seen as a series of statements, called premises, presented to establish the truth or probability of another statement, called the argument's conclusion. There are many logical fallacies that appear to prove the truth of the conclusion but really do not do so. Examples include:

Circular Reasoning or Begging the Question: A circular argument is one in which the premise or premises assume the truth of the conclusion to "prove" the conclusion.

> "Scripture says that God exists. We know that what Scripture tells us is true because it is the Word of God. Therefore God exists."

This is not an argument so much as amplification or a reiteration. Unless the reader already agrees that God exists, the premises give the reader no new reason to believe that God exists.

Appeal to Force *(Argumentum ad Baculum):* This logical fallacy involves using a threat or a cause for fear, rather than a reason for belief, as "support" for the truth of the conclusion.

> "If you insist on publishing your latest scientific findings we will lose our government funding. Your findings must be incorrect."

Appeal to Popular Opinion or Conduct *(Argumentum ad Populum):* This mistake is made when a person assumes that a belief must be correct or a type of conduct appropriate because it is popular or common.

> "CrummyCola is the most popular soft drink in the world. CrummyCola must be good for you!"

> "Everybody tells lies once in a while. Lying can't be wrong."

Personal Attack *(Argumentum ad Hominem):* This logical fallacy takes advantage of the mistake of assuming that because the person advancing a position has or had some character flaw or defect, that person's position must itself be wrong.

> "Thomas Jefferson owned slaves. We should not take seriously a single one of Jefferson's political beliefs."
>
> "Ulysses S. Grant was an alcoholic. He must have been a terrible general."

Appeal to Pity: With this fallacy, rather than giving reasons why the reader should accept the truth of the conclusion, the person merely appeals to the reader's emotions.

> "Giving money to Charity X is the best way to help end poverty. Did you see those sad pictures of starving children in Charity X's new commercial?"

Hasty Generalization: This fallacy is simply a matter of moving from a specific instance to a general claim without due reason. The mistake here is to assume that any sample is a representative sample.

> "I like black-and-white movies better than color movies. My friends agree. Therefore, black-and-white movies are more popular than color movies."
>
> "That cabdriver overcharged me. Cabdrivers are such thieves."

False Dilemma: The mistake here is to divide a subject into two antithetical components and to exclude any cases that might land in the middle. This is sometimes called thinking in black and white — ignoring or forgetting the gray areas.

> "America. Love it or leave it."
>
> "Either you support the President or you don't."

Complex Question: This is a question to which any response would be incriminating.

> "Do you still drink before class?"

False Analogy: This fallacy involves drawing an improbable conclusion about one thing based on a correct conclusion about something unrelated or improperly related. The mistake occurs when one imagines an equation or direct similarity between two different things.

> "You can't make an omelette without breaking eggs. Sometimes it's necessary to mistreat a student for the good of the whole class."